DOES THE COELACANTH OCCUR IN THE EASTERN CAPE?

by MICHAEL BRUTON

INTRODUCTION

When a coelacanth was caught off the mouth of the Chalumna River in December 1938, it caused dismay throughout the scientific world. How was it possible that a representative of this ancient group, which was thought to have died out with the dinosaurs at the end of the Cretaceous 70 million years ago, could have survived for so long? After all, coelacanths first appeared in the fossil record over 390 million years ago and reached their peak of diversity about 220 million years ago during the Triassic (Forey 1988). The surprise was further compounded by the fact that coelacanth fossils were mainly known from shallow seas and bays in temperate latitudes (although this may be an artifact of the fossil record). Furthermore, fossil coelacanths are typically relatively small fishes (> 100 cm) whereas the living coelacanth *Latimeria chalumnae* (Fig. 1) reaches over 183 cm. Recent research findings on the morphology, behaviour, biology and physiology of this idiosyncratic animal have continued to astound scientists — it is clear that the coelacanth makes its own rules! In this note I will evaluate the conservation status of the coelacanth and address the question: Does the coelacanth occur in the Eastern Cape? by reviewing our knowledge of its biology and relating these findings to the marine environment off the Eastern Cape coast.

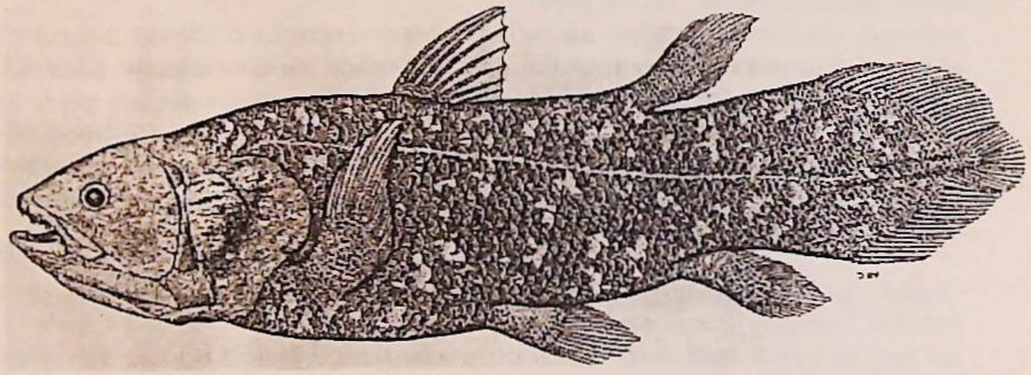


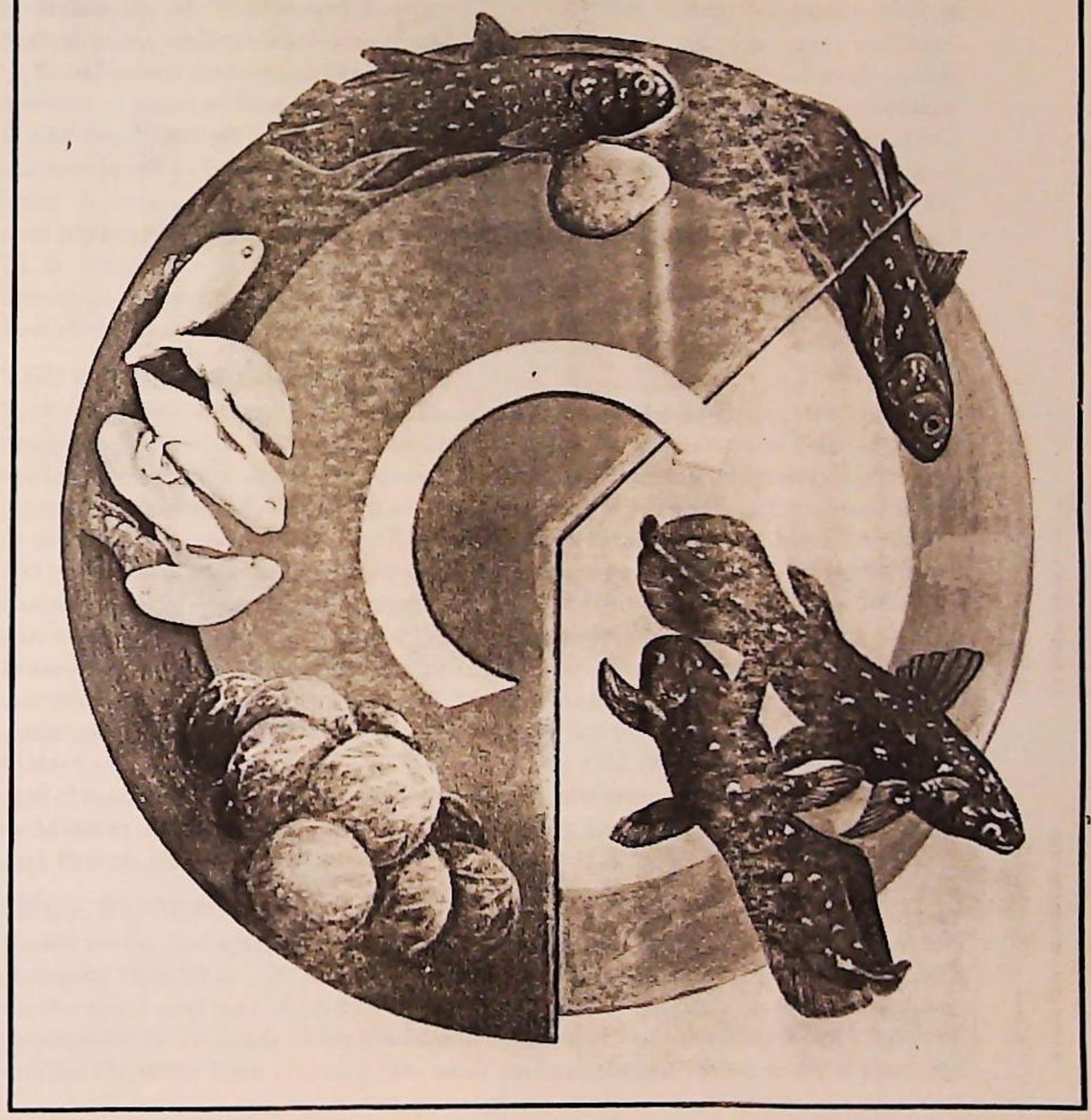
Fig. 1: The living coelacanth *Latimeria chalumnae* (drawing by D.P. Voorvelt).

THE INITIAL CAPTURE

The first coelacanth was caught at a depth of about 70m on 22 December 1938 by the trawler 'Nerine' skippered by Captain Hendrik Goosen, about 5 km offshore of the Chalumna River mouth, some 32 km south-west of East London. Discussions I have had with Captain Goosen have revealed that there had been a cold water upwelling that day and that he had bagged an unusual catch of deepwater sharks and rays, in addition to the coelacanth. Goosen was in the habit of keeping unusual fishes for the East London Museum as a result of an earlier contact with the Museum's Curator Miss (now Dr) Marjorie Courtenay-Latimer. Miss Latimer

The Naturalist

VOLUME 33, PART 3 NOVEMBER 1989 PRICE R3.00



realised that the large, deep blue fish was unusual and immediately contacted the Honorary Curator of Fishes of the East London Museum, Professor J.L.B. Smith, then a Senior Lecturer in Chemistry at Rhodes University in Grahamstown. Smith was a keen student of fishes and soon realised that the fish in East London was a representative of the Crossopterygii or lobe-finned fishes. He formally described the new species *Latimeria chalumnae* and soon he and Miss Latimer were inundated with letters and telegrams from all over the world, some laudatory, but others disbelieving or even derogatory. Some suggested that the coelacanth had not been alive when caught but had lain for millions of years in anoxic ooze whereas Dr E.I. White of the British Museum proposed that the living coelacanth "almost certainly was a wanderer from deeper parts of the sea to which its kind have retreated in the face of fierce competition with the more active modern types of fishes." (Smith 1956).

J.L.B. Smith did not agree with this theory. His thorough knowledge of fish biology and anatomy led him to state: "The first thing that struck me was that this East London coelacanth was most likely a stray. Its body shape shows it is not speedy; its heavy scales would be perfect protection from casual bumps on rocks or coral. As it had apparently never been seen before, it was not likely to live anywhere where many people fished or where it could easily be caught on a line. This to me said clearly: moderately deep water with a rough, rocky bottom, washed by a strong current and probably rough or dangerous seas. My mind at once turned to the vast reef system of East Africa. Further, one of the places where coelacanth fossils have been found is Madagascar" (voice recording in the archives of the Smith Institute). He concluded further that "The whole weight of evidence therefore seemed to be unquestionably against the possibility that the Coelacanth could be living in the sea anywhere near East London, even at fair depths among reefs". Despite Smith's proposal that the East London coelacanth was a stray from more tropical waters, the possibility cannot be ignored that the species may occur off rocky shores along the coasts of mainland Africa or Madagascar.

OTHER SOUTH AFRICAN CAPTURES?

There are no other confirmed records of coelacanths being caught off South Africa. In the early 1940s the Sea Fisheries Research Institute vessel *Africana I* trawled repeatedly on the continental shelf along the coast near East London, but no coelacanths were caught. In 1950 J.L.B. Smith received a letter from Mr Bert Spring, the lighthouse keeper at Cape St Blaize near Mossel Bay, who stated that he had seen a coelacanth swimming near the surface of the water, but this record was also not confirmed. Recently I had the privilege to visit the old boardroom of the famous shipping and timber company in Knysna, Thesens, courtesy of the wellknown novelist, Hjalmar Thesen. He showed me a remarkable painting by his uncle, Leonard Thesen, which quite clearly depicts the coelacanth, resplendent in blue with white flecks, along with other common fishes from that area, such as leervis, kob and parrotfish. The painting was originally done on a piece of curtaining for a cottage purchased in 1924 but has since been framed and covered with glass. A label on the glass states that the painting dates from 1925, which would be extraordinary if it is true. According to relatives, Leonard Thesen was not a keen

angler but he was an enthusiastic beachcomber, and the possibility cannot be dismissed that he found a coelacanth that had been stranded after one of the cold water upwellings which are typical of that area. Leonard Thesen may have known to J.L.B. Smith, and almost certainly knew of his work on the coelacanth after 1939, but the evidence available indicates that the painting was done before then. Although he was a subscriber to the 1949 edition of Smith's 'Sea Fishes' book, he never told Smith about his coelacanth painting, and he took his secret with him when he died in 1951.

A MOZAMBIQUE COELACANTH?

The only other hint that coelacanths may occur on the coast of the African mainland is the detailed account supplied to J.L.B. Smith and published in newspapers in Rhodesia, South Africa and England by a Mr Geoffrey Cartwright, a Salisbury businessman. Mr Cartwright claims to have seen the fish in November 1952 in shallow water, while snorkel-diving off Malindi in northern Mozambique, and states "I found myself staring into its baleful green eye. The creature looked so menacing and evil — and a million years old — that I was thoroughly scared for the moment. It had cruel jaws set with fierce dagger-sharp teeth... It made no move to attack but continued to tread water with its strange fins almost like a malformed human hand. It weighed, I'm sure, about 150 lbs. and had thick, bluish grey scales like steel plating. The thing was like some denizen out of a marine nightmare". Although J.L.B. Smith gave some credence to this record, as well as to another by a native fisherman at Bazaruto, subsequent research has revealed that it is very unlikely that a snorkel-diver would encounter a coelacanth in shallow water.

THE COMOROS COELACANTHS

In the late 1940s and early 1950s J.L.B. Smith, his wife Margaret and various helpers (including their son William) collected fishes off the east coast of Africa, all the while keeping an eye open for the coelacanth. They distributed thousands of reward posters, and eventually in 1952 a second coelacanth was caught off Anjouan Island in the Comoros archipelago and brought back to Grahamstown. Since then, over 150 coelacanths have been caught off Grande Comore and Anjouan islands in the Comoros, but nowhere else, although there is an unconfirmed record from the north-east coast of Madagascar. From 1953 to the mid-1970s most coelacanths went to France, but more recently scientists from a number of other countries have collected and studied the coelacanth. The J.L.B. Smith Institute of Ichthyology recommenced coelacanth research in 1986 and since then its staff has participated in four expeditions to the Comoros (Heemstra & Smale 1987, Stobbs 1987, Bruton et al. 1989). A great deal of research has now been published on the coelacanth, much of which is reviewed in Millot et al. (1972), McCosker & Lagios (1979), Locket (1980), Balon et al. (1988) and Bruton (1989).

BRIEF REVIEW OF COELACANTH BIOLOGY AND ECOLOGY

Except for the first specimen, all coelacanths have been caught off steep rocky shores at depths from 80 to 300 m on the west and south shores of Grande Comore and on the north and east shores of Anjouan (Fig. 2). Observations from a research submersible by Professor Hans Fricke and co-workers from the Max-Planck Institute in West Germany have revealed that most coelacanths are found at the deeper end

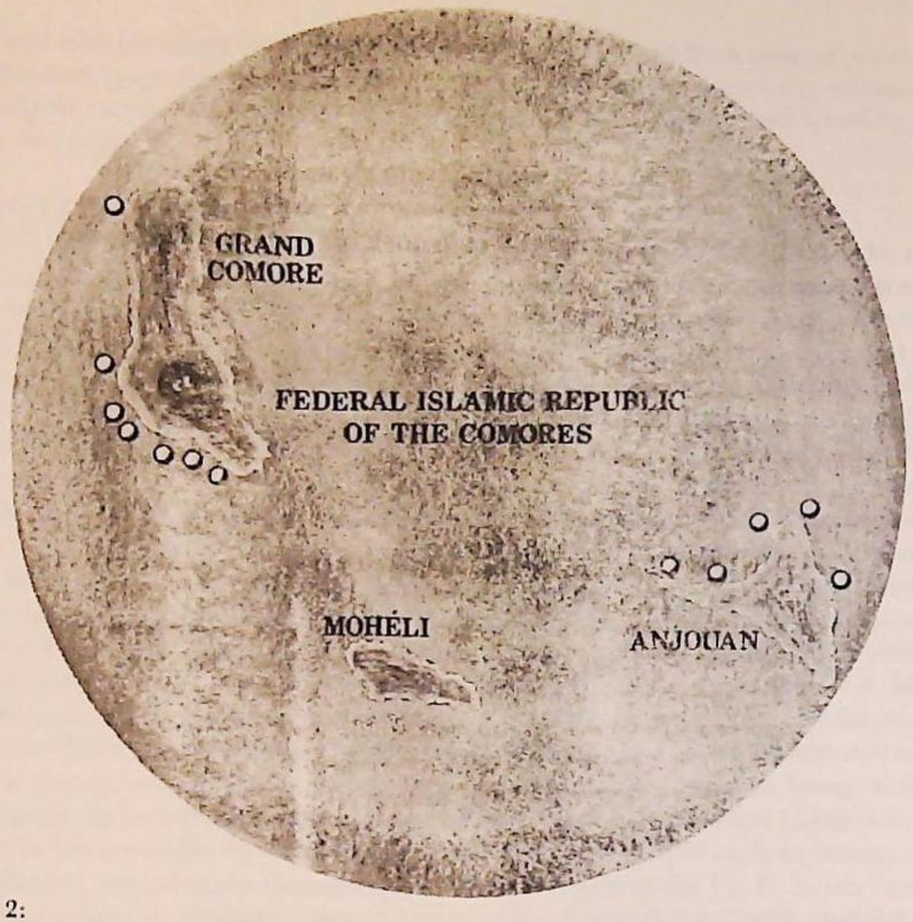


Fig. 2:
Diagram of the Comoros showing the main localities at which coelacanths have been caught (drawing by D.P. Voorveld)

of the submersible's range (200m) at water temperatures less than 18°C. Investigations of coelacanth blood have revealed that the oxygen affinity of the haemoglobin is reduced at temperatures higher than 18°C (Hughes & Itazawa 1972), which may explain why the coelacanth lives in deeper water and migrates into shallower, cooler water at night (Fig. 3) (Fricke & Plante 1988). Coelacanths that have been hauled to the surface show respiratory stress and soon die. On the basis of its narrow habitat preferences, Fricke & Plante (1988) have predicted that further coelacanth populations will not be found in the western Indian Ocean as no suitable habitats exist other than in the Comoros, but I am more hopeful.

In a sample of over 100 specimens, the average size of males is 130 cm and of females 150 cm, and the largest individuals are consistently females. The largest specimen we have examined was a female of 183 cm. Estimating the age of adults is problematic because of the indistinctness of the rings on the scales, but a longevity of 20 to 25 years is likely. Coelacanths have a very interesting life history and an advanced method of breeding (front cover illustration). Fricke has observed coelacanths swimming in pairs and it is thus possible that they pair off during the

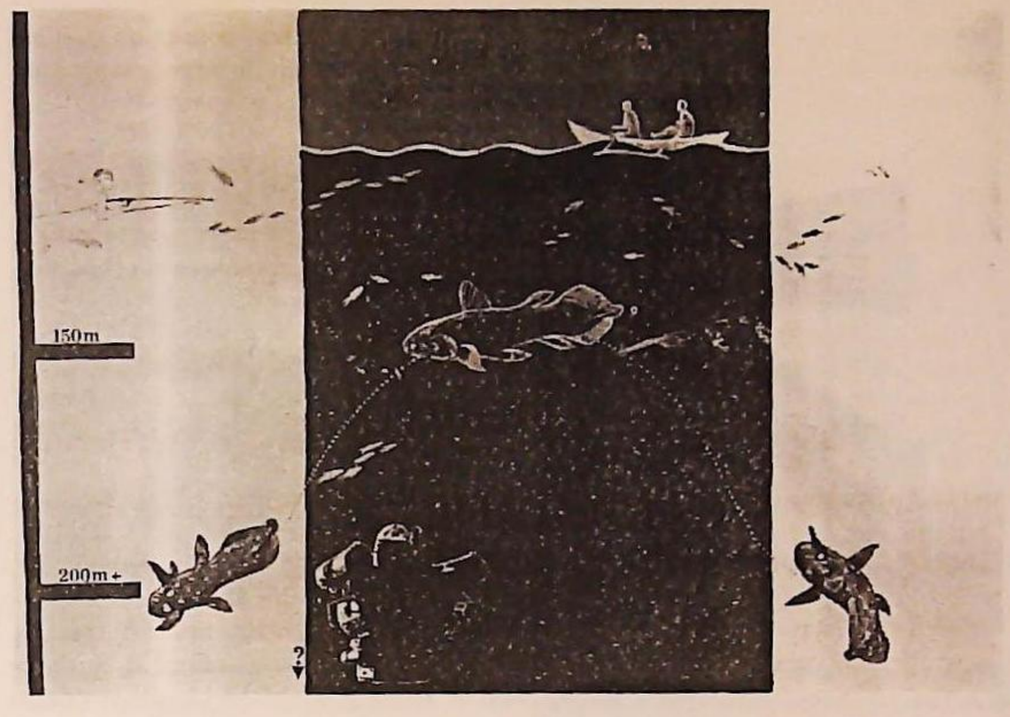


Fig. 3:
Diagrammatic representation of the vertical migration of the coelacanth into shallow water at night. The maximum depth at which a coelacanth has been observed from a submersible is about 200m (drawing by D.P. Voorveld)

breeding season. The males have an intromittent organ and fertilisation is internal. The gestation period is thought to be about 13 months. Coelacanths differ from most bony fishes in that they produce a few, very large eggs and young. One 163 cm female contained 19 ripe but probably unfertilised eggs about 9 cm in diameter and 325 g in weight. The eggs were about the size and colour of an orange and are the largest eggs of any fish. Another female contained five fully-formed yolksac juveniles of 32 cm and 550 g. The mode of reproduction of the coelacanth — high parental investment in a few young that are born as large and capable predators — means that this species may be well adapted to highly competitive environments but may be vulnerable to man-induced mortality rates. This mode of breeding may have existed in coelacanths over 150 million years ago as Watson (1927) found two young fetuses within the fossilised body cavity of an *Undina* species from the Jurassic.

The method of swimming of the coelacanth is unique. The paired pectoral and pelvic fins are used alternately (left pectoral and right pelvic sculling together) in the manner of a four-legged animal. The unpaired lobed second dorsal and anal fins are sculled in unison from one side to the other. The large caudal fin is usually held rigid while drift-swimming but provides powerful propulsion during a rapid forward burst. The coelacanth feeds on small, bottom-living reef fishes (snappers, cardinal fishes) or mesopelagic fishes (lantern fishes) as well as on cuttlefish. Their feeding behaviour has not as yet been observed but they are capable of rapid bursts

of speed and probably drift slowly towards their prey and then pounce on it. The predators of the coelacanth are unknown but are likely to include large oceanic and reef sharks; a number of coelacanth specimens, including the second found in 1952, have fins missing.

CONSERVATION STATUS

In 1963 J.L.B. Smith already warned that the coelacanth may be threatened by man's activities. Our recent research reveals that a number of factors, both socio-economic and biological, threaten the survival of the coelacanth (Figs 4 & 5). The economy of the Comoros is very dependent on the utilisation of natural resources and there is a heavy fishing pressure on the narrow inshore reefs of these steep sloping, volcanic islands (Stobbs 1987). The Comorans are skilled fishermen and operate from hand-paddled outrigger canoes in the open ocean. Their main target species is the oilfish *Ruvettus pretiosus* but coelacanths are occasionally caught by accident. The annual catch rate for coelacanths since 1952 has ranged between 0 and 12 with an average of 5,5, but accurate catch statistics are not kept and the catch rate may be higher.

The coelacanth is currently listed on Appendix II of the Convention on International Trade in Endangered Species (CITES), which means that it may not be traded if that trade threatens its survival. An application has been submitted to upgrade the coelacanth to Appendix I of CITES so as to afford it further protection. The coelacanth was included in the International Red List for the first time in 1986 but was listed in category 'K', which means that insufficient was known about the species for it to be categorised. Representations are now being made for the species to be listed as 'endangered'. A Coelacanth Conservation Council/Conseil pour la Conservation du Coelacanthe was established in 1987 with its headquarters in Moroni, capital of the Comoros, and the secretariat at the J.L.B. Smith Institute of Ichthyology in Grahamstown. Centres of the Council have been established in the Far East, Europe and North America. The objectives of the Council are to promote and coordinate coelacanth research and conservation and to mount an educational campaign on the importance and value of the coelacanth.

One of the main factors threatening the survival of the coelacanth is that the only known breeding population occurs off the Comoros, an island group which is subject to heavy fishing pressure but does not as yet have the scientific expertise to manage their fish stocks. It is widely thought, therefore, that actions to conserve the coelacanth should be divided into two groups: (a) to conserve existing stocks in the Comoros, and (b) to locate other populations of the coelacanth, if they exist, and to ensure their survival. South Africa, as the most technologically advanced country on the eastern seaboard of Africa, is ideally situated to lead these initiatives, and one of the first priorities should be to establish whether coelacanths live off our coast.

COELACANTHS OFF THE EASTERN CAPE COAST?

In general, the east coast of Africa bears little resemblance to the coasts of Grande Comore and Anjouan; it is eroded with a wide, sandy continental shelf and relatively little exposed rock. Water temperatures from the surface to the shallow sandy shelf often exceed 18°C and there is relatively little inshore current. The situation is, however, different on the coast adjacent to the Transkei, Ciskei and adjacent parts

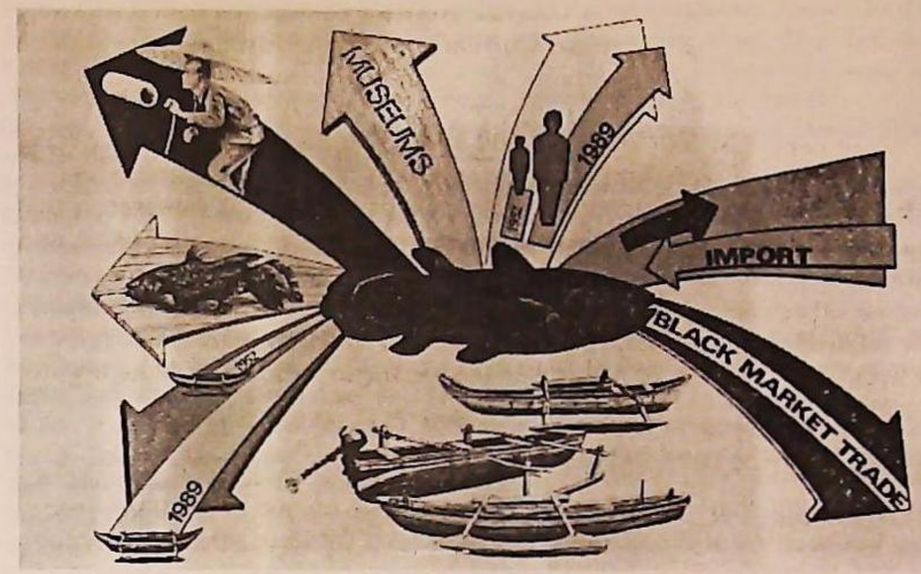


Fig. 4:
Socio-economic factors threatening the survival of the coelacanth (clockwise from top right): rapidly expanding human populations in the Comoros, a large trade imbalance and weak economy in the Comoros, a black market trade in the coelacanth, increased fishing efficiency and increased fishing effort, poor methods of preservation and taxidermy of the specimens that are caught whichrenders them useless for study, and the rumour among Far Eastern people that the fluid in the notochord of the coelacanth promotes long life (drawing by D.P. Voorvelt).

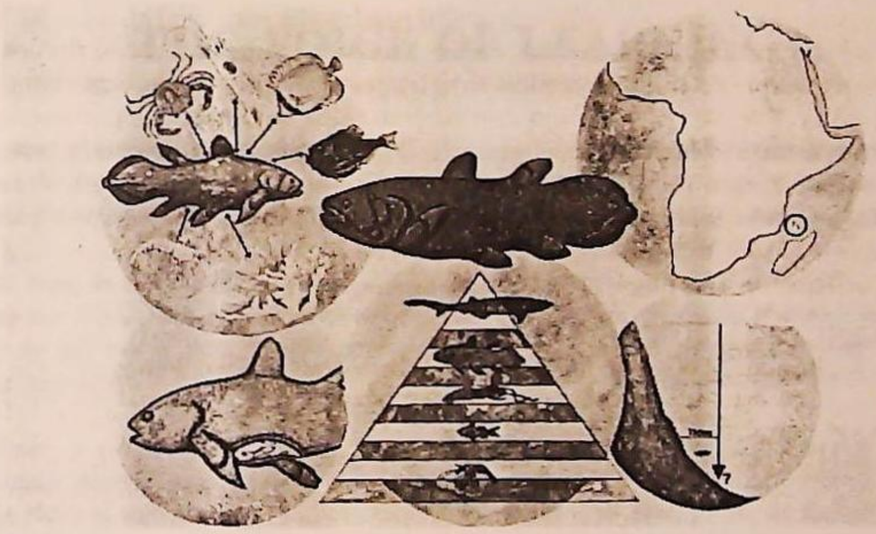


Fig. 5:
Biological factors threatening the survival of the coelacanth (clockwise from upper right): their narrow geographical range, their narrow habitat tolerances, their height in the food chain, their slow breeding rate and their membership of a complex community (drawing by D.P. Voorvelt).

of the Cape Province, including East London. Here the continental shelf is relatively narrow and the south-flowing Agulhas Current comes close inshore; there are also abundant offshore rocky reefs. Atlasses of ocean temperatures (e.g. Gordon & Modinelli 1986) reveal that water temperatures of 18, 17, 14, 13 and 9°C can be expected at depths of 100, 200, 350, 500 and 750m respectively, which are all within the range of the coelacanth. Furthermore, this area is the southern limit of the range of many tropical fishes. The most trenchant evidence, however, is that a living coelacanth has already been caught there, which means that biotic and abiotic conditions in the area are within the range of tolerance of the species. Why then have no other coelacanths been caught off our coast? The answer probably lies in the relatively secretive ways of the coelacanth, the deep inaccessible reefs on which it lives, and the absence of suitable fishing methods in deep enough water off our coast.

CONCLUSION

It is very important that we should establish whether or not coelacanths live off our coast, but this is a difficult and expensive task. Trawling and longlining are unlikely to be cost-effective, and SCUBA divers cannot go deep enough. A manned research submersible similar to that used by Professor Hans Fricke would be the best method but a remote-controlled submersible would also suffice. In 1987 Professor Fricke agreed to bring his submersible to South Africa if we could arrange a mothership and sponsorship. We made contact with the South African Navy and a number of senior personnel showed great interest in the project, which was scheduled for early 1990. Unfortunately financial cutbacks torpedoed the project and it has had to be postponed. Or maybe we did not pursue the matter aggressively enough or approach the right people. Somehow the spirit of enterprise and excitement associated with J.L.B. Smith's early expeditions needs to be rekindled in South Africa. When last did a scientist phone the Prime Minister in the middle of the night asking him to supply a military aeroplane to fetch a dead fish in a foreign country? Perhaps we need to be bolder in our approach to those who hold the purse strings or have the means to facilitate our research. Time is running out as all evidence points to the fact that the coelacanth could become extinct within 20 years unless concerted action is taken to save it. Do we as South Africans not have a moral responsibility to save this fish which played such an important role in putting South African science on the map 50 years ago, from extinction?

REFERENCES

Balon, E.K., Bruton, M.N. & Fricke, H. 1988. A fiftieth anniversary reflection on the living coelacanth, *Latimeria chalumnae*: some new interpretations of its natural history and conservation status. *Env. Biol. Fish.* 23: 241-280.

Bruton, M.N. 1989. The living coelacanth fifty years later. *Trans. R. Soc. S. Afr.* 47: 19-28.

Bruton, M.N., Buxton, C.D., Hughes, G.R. & Stobbs, R.F. 1989. Recommendations on marine conservation in the Federal Islamic Republic of the Comoros. Invest. Rpt J.L.B. Smith Inst. Ichthyol. 33: 1-104

Forey, P.L. 1980. *Latimeria*: a paradoxical fish. *Proc. R. Soc. Lond.* B204: 369-384.

Forey, P.L. 1984. The coelacanth as a living fossil. pp. 166-169. In *Living Fossils*, Eds. N. Eldredge & S.M. Stanley, Springer Verlag, New York.

Forey, P.L. 1988. Golden jubilee for the coelacanth *Latimeria chalumnae*. *Nature* 336: 727-732.

Fricke, H. 1988. Coelacanths. The fish that time forgot. *Nat. Geogr. Mag.* 175: 824-838.

Fricke, H. & Plante, R. 1988. Habitat requirements of the living coelacanth, *Latimeria chalumnae* at Grande Comore, Indian Ocean. *Naturwissenschaften* 75: 149-151.

Gordon, A.L. & Molinelli, E.J. 1986. *Southern Ocean Atlas: Thermohaline and Chemical Distributions and the Atlas Data Set*, New Delhi, Amarind.

Heemstra, P.C. & Smale, M.J. 1987. Fisheries resources of the Islamic Republic of the Comores, with recommendations for the wise use and conservation of the marine fauna of these islands. Invest. Rpt J.L.B. Smith Inst. Ichthyol. 23: 1-34.

Hughes, G.M. & Itazawa, Y. 1972. The effect of temperature on the respiratory function of coelacanth blood. *Experientia* 28: 1247.

Locket, N. 1980. Some advances in coelacanth biology. *Proc. R. Soc. Lond.* B208: 265-307.

McCosker, J.E. & Lagios, M.D. (eds.) 1979. The biology and physiology of the living coelacanth. *Occ. Pap. Calif. Acad. Sci.* 134: 1-175.

Millot, J., Anthony, J. & Robineau, D. 1972. Etat commente des captures de *Latimeria chalumnae* Smith (Poisson, Crossopterygien, Coelacanthide) effectues jusqu'an mois d'Octobre 1971. *Bull. Mus. Natn. d'Hist. Nat. Zool.* 39: 533-548.

Smith, J.L.B. 1956. *Old Fourlegs, the Story of the Coelacanth*, London, Longmans Green, 260 pp.

Stobbs, R.E. 1987. The galawas of the Federal Islamic Republic of the Comores, with notes on artisanal fishing and recommendations for a maritime museum. Invest. Rpt J.L.B. Smith Inst. Ichthyol. 25: 1-2.

Watson, D.M.S. 1927. The reproduction of the coelacanth fish *Undina*. *Proc. Zool. Soc. Lond.* 1: 453-457.

Michael Bruton, J.L.B. Smith Institute of Ichthyology, Grahamstown.

THE VOICE OF LEARNING

The voice of learning prates finalities
About the deepest mysteries
In the precincts of the university

"The living fossil coelacanth is more
Than just a relic from some forgotten era
It is the only relic of those forgotten genera
That gave us life."

Evolution is a tight-rope
A shining gleaming phantom path
That ghosts of men pursue
With blindly groping souls
That learned men tread learnedly
Bewitched by phantom goals

Man, that highest vertebrate
That ultimate in love and hate
Producer of complexity and
Dweller of the city
If your past is buried
In the depths of hidden time
Then you might need the sunset
and the softness of the rain

But the Voice of Learning finally
Dies of yearning fruitlessly.
It forgot to tell its students
to learn to love the rain.

C.G.P.